Vol. 5, No. 4 November, 1954

SYSTEMS AND PROCEDURES QUARTERLY

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PUBLISHED BY THE SYSTEMS AND PROCEDURES ASSOCIATION OF AMERICA

SPA Quarterly

Official Journal of the

Systems and Procedures Association of America

November 1954

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The Quarterly is published by the Systems and Procedures Association of America, Box 281, Wall Street Station, New York. Yearly subscription rate $3.75, two years, $6.75, single copies $1.

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Let's Talk About

Operations Research

A CONCISE presentation of a valuable management activity, with a few case histories to lend perspective.

by Frank T. Hulswit

DR. ROBERT F. RINEHART, who is president of the Operations Research Society of America, has suggested a simple and fairly accurate definition of operations research, namely, "The exterior application of the methodology and tools of science," where by exterior is meant problems outside the normal habitat of science. Industrial operations research has typically tackled problems relating to the operation of business organizations.

Operations research defined this way is not, strictly speaking, a new concept. Early appearances of it are the research out of which time and motion study and quality control have developed. What may be said to be new about present day operations research is its far greater breadth and depth caused by the discovery that many more methods and tools of science can be fruitfully applied outside the field of science itself, and that the area of fruitful application is much larger, than had previously been realized by either scientists or non-scientists generally.

Being a science, operations research attempts to understand, not to act. When an operation is understood, when the mechanism (or systematic organization) underlying the observed facts is discovered, the action to improve the process is often fairly evident. It is in the obtaining of this initial understanding that the scientific method comes in.

The scientific method, which combines quantitative hypothesis, observation, and controlled experiment, is typical of research in the physical sciences and operations research. Its essential elements include the development of a simplified quantitative model of the operation studied and the testing and refinement of the model by quantitative observation, controlled experiment, and statistical analysis. Rather than reasoning from the facts to the mechanism, as in some forms of statistical analysis, the operations research scientist more often sets up assumed models or theories in order to deduce phenomena to check against the observed facts. The details of the model or theory are usually expressed mathematically and the consequences of alternative courses of action, suggested by the model, are derived by mathematical procedures.

Surprisingly simple models derived in this manner, expressing the effects of a few important factors, can often provide an understanding of very complex operations.

Measures of Effectiveness

In tackling many problems, the operations research approach may commence with the selection of measures of effectiveness in terms of which the success or failure of an operation is to be judged. These may be quite different from those previously employed.

As an example, during the war the Navy provided crews to man anti-aircraft machine-gun defenses for merchant vessels. It was noted that the proportion of attacking enemy aircraft shot down by such batteries was very small compared with AA experience of naval warships, It was suggested, therefore, that the naval gun crews could find better employment elsewhere and should be withdrawn from merchant vessel assignment.

Closer study indicated, however, that in the case of merchant vessels defended by machine-gun batteries, the

ships hit per attacking aircraft were much lower than for undefended vessels. The correct measure of effectiveness to employ in this decision was ships hit per attacking aircraft, rather than aircraft shot down per attack, since the purpose of the guns was to protect the ships from damage due to enemy aircraft.

In studying the effectiveness of a chain of retail outlets for a large manufacturing company we found that different officers of the company were, perhaps unconsciously, applying widely differing measures of effectiveness in reaching conclusions as to the success of the retail chain.

Different Views

The president felt that the chain should be operated in such a manner as to maximize profits to the company; the treasurer wanted to see them adjusted so as to maximize return on invested capital; the sales manager was interested in gross margin, or sales less sales expense. It was discovered that these varying measures of effectiveness were mutually incompatible, and that the store chain could not be operated to maximize them all at once. It was necessary to develop a new and different measure which represented in proper proportions the interests of the various officers of the company, and to which they could all agree.

Similarly, questions concerning production scheduling and inventory control are often characterized by conflict among the interests of the companies' chief production, sales, and financial officers. These conflicts concern appropriate production and distribution schedules and the resulting inventories. When sales are seasonal the production manager often wishes a level production schedule, letting inventory build up during periods of low sales, since this allows most efficient use of his production equipment and labor force. The treasurer, on the other hand, wishes production to follow sales as closely as possible to keep inventories and the resulting capital investment to a minimum. The sales manager wants to be sure that adequate inventories are maintained at all times to compensate for unforeseen fluctuations in sales and to allow for a uniform high level of service to customers. These conflicts among parts of a company organization and the resulting series of meetings seeking compromise solutions can be expensive and time-consuming, and can result in postponement of decisions to the extent that the eventual decision may be made on a precipitate and unsound basis.

Clerical Tasks — Estimating Their Magnitude

The management of a large company was disturbed by the increased costs of their record-keeping activities. These included records on factory and warehouse inventory, payrolls, sales, sales compensation, etc.

The Standards Department had done excellent work in setting up job load ratings for individual clerk effort. However, no quantitative method existed for comparing the overall efficiency of each of these operations. Comparison was particularly difficult since many different types of mechanical records-keeping systems were in use, including everything from purely manual systems to complete IBM installations.

An operations research group was asked to develop measures of effectiveness for such record-keeping information-handling systems so that the size and complexity of these diverse systems could be measured in comparable units. Moreover, methods were needed to assess quickly the values of these measures.

This was done by developing a mathematical model of idealized information-handling systems. This model was evolved from work done in the comparatively new field of information theory which was developed to measure the inherent capacity of electrical communications channels.

The methods were developed requiring knowledge only of these factors:

Inputs—new information flowing into the system, for example, time cards, name and job description for new employees in a payroll system.

Outputs—information withdrawn from the system—checks, withholding reports, labor distribution reports.

Stored data—material on file needed to convert inputs to outputs—employee record files, deduction authorization.

No specific data about the processing of this material was needed to determine the theoretical information-handling capacity required. For calculation of these measures it makes no difference whether the work is done by old men on high stools with quill pens or by Univac or whether the work is done efficiently or not. These measures relate to the inherent amount of information-handling work involved in each system, not to the effort actually spent in a given application.

Following application of these methods a comparison could be made between the actual costs for each job for the theoretically required information-handling capacity. The costs of most operations were fairly close to the calculated theoretical minimum and those which were seriously out of line in cost could be easily spotted.

Further work, by application of cost factors typical of each of the existing mechanical information-handling systems, should determine whether the high-cost systems

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Mr. Hulswit's article is based on the talk he gave earlier this year at a combined meeting of the Boston and Bay State Chapters. He works for Arthur D. Little, Inc., Cambridge, Mass.

are expensive because the processing devices in use are not suited to the operations or because the flow of process in steps is inefficiently designed. Also, by application of estimated cost factors for information-handling systems under development the theory should indicate that machine system which will minimize the cost of each operation.

A great deal has been said from time to time concerning the techniques used in operations research. Attempts have been made to associate operations research with specific techniques, frequently with statistical methods, often with particular branches of mathematics, sometimes with rather specialized forms of engineering. However, the identification of operations research with any specific technique must be recognized for what it is—an oversimplification and a misapprehension. Mathematical and experimental techniques help the research attack, but no amount of technique can replace it. The research scientist will use any techniques at his disposal which fit the problem. Some of the techniques which have been found particularly useful in operations research problems include the calculus, differential equations, statistical mechanics drawn from physics, linear programming, and the theory of experimental design drawn from statistics. Communications theory, servomechanisms theory, symbolic logic, and queuing theory have all provided bases for solving operations research problems.

Scientific Research

To summarize, I think we can say that operations research is a branch of scientific reasearch, which is concerned more with reaching a quantitative understanding of the factors influencing an operation than with simply describing the relations among the numbers associated with the operation. It is usually carried on by teams of people, drawn from engineering, mathematics, and the physical sciences. It certainly is not new, except possibly in the growth of the idea of bringing together the approaches and techniques of many disciplines, to bear on management problems where they had not been used together before.

Operations research groups have been formed in quite a few companies usually dominated initially by a single type of training, then bringing in others. In a company manufacturing small precision instruments the group commenced with an industrial engineering outlook and was concerned at first with optimum allocation of machines among operating and maintenance personnel, determining causes of machine down-time, etc. The group has now taken on additional personnel and new problems in quite different areas, such as determination of the best guarantee policy of the company.

In one petroleum company the operations research group commenced with a chemical engineering point of view and first tackled problems of the best product mix for a particular refinery, in the light of its choices of raw materials, and of the changing price structure met by its products as they emerged into the market. In another petroleum company, however, the operations research activity has a strong market research flavor, and has been concerned primarily with means for selecting the types and locations of gasoline service stations in the light of changes in automobiles, highways, and driving habits.

Operations research has shown that it complements rather than competes with or supplants, other services available to the executive such as market research, accounting, and industrial engineering. These fields have grown tremendously in recent years and have developed powerful new techniques for finding information and answers in the areas toward which they are directed. Any well-balanced industrial operations research team should have available men who are experts in these fields to advise the operations research team on questions specifically related to their fields of specialty.

The proof that operations research and these other management activities are complementary and not competitive lies in the fact that industrial operations research has shown that it can proceed most rapidly and economically in those companies in which other management service activities have already been developed to a high level of efficiency. In such situations, the role of operations research is frequently that of integrating information, of using expert opinion, as well as factual data, provided by these other services in an organized, comprehensive, and systematic analysis directed toward management problems. **s/p/a**

Neat economy

In many instances, a tabulated run is needed in more copies than can be satisfactorily produced by carbon in a single pass through the tabulator. We solved this problem at virtually no extra cost by using standard fan-fold continuous two-part form paper of which we carry a substantial stock. This paper is fed into the tabulator upside down so that the carbon paper is face up against the type bars. The transfer of carbon to the back of the original produces the additional intensity of image required to yield very satisfactory copies on the diazo machines. This is not special paper. It is the regular weight paper used in all tabulating installations. There is little waste involved because the duplicate sheet comes out of the machine clean, unmarked, and ready for use as a single-part form when the occasion demands.—From "Modern Office Reproduction Methods," ARCH B. JOHNSTON, at the Third Annual Systems and Procedures meeting, San Francisco.

Question—

Should the systems man be held accountable for complete installation of procedures which he develops, proposes and obtains approval?

Editor's note: The affirmative stand on this question was presented in the May 1954 issue of the QUARTERLY. Here is an opinion on the negative side.

Beverly Hills, August, 1954

Dear Editor:

Mr. Stamberg's affirmative points are well taken, and every situation and organization merits its own application of the principles and benefits involved.

My negative stand is based on the desirability of making the best use of a systems man and on the necessity of fullest possible participation of those who will eventually be responsible for the operation of the system. We're all aware of the importance participation plays in the success of all systems work. Thus let's consider . . .

1) that those persons doing the work and directly responsible for its results need to learn, experience, and practice it. The best way is for them to participate in the system's development and to nurse it through its growing pains, becoming as familiar with its history and reasons as the systems man.

2) that none of us systems men are all-perceiving. Those directly concerned with the work have a lot to contribute during all stages of a system's development and installation. From the standpoints of organization morale and systems success, and just because we are selfish and lazy, we systems men should provide the framework and working relations with the operating people that will generate and use the maximum number of their ideas. Release of the reins is necessary for this kind of atmosphere. When confidence and cooperation are mutually assured, the systems man can release them freely, knowing that his advice and suggestions will be followed when he injects them in an advisory capacity, and that he will not be shut off from the happenings and changes that affect the system.

3) how preferable it is that the systems work of an organization be carried out by a very few highly-skilled (and highly-paid) systems men with a full understanding of the overall complex of operations, working in a respected advisory capacity with those having line responsibilities and intimate contact with the work. It's necessary for integrated systems, for elimination of duplication, and other cures of business inefficiencies. It's a little hard on company politics and empire building, but we aren't supposed to like these bogies. Detaching the systems man from accountability frees his time so that he may be continually learning, observing, and discussing—and thus gain a better understanding of both the overall situation and the details than he would otherwise. Compare this, if you will, with the havoc a lot of little systems men working relatively independently on limited projects can wreak on an organization. The wise systems man uses the rest of the organization (from president to clerks) as his staff, and benefits not least from their resulting appreciation of his problems and objectives.

4) that a systems man should not be in the position of needing to prove the worth of his system, for that builds resistance and lack of cooperation and his own reluctance to change it when the requirements of actuality differ from his anticipations. To be held accountable for a system usually means to need to prove its merits.

5) that to make him accountable and thus tied down to the details makes most inefficient use of a systems man's time, for data processing loads and frequencies show many peaks and valleys.

6) that double and triple checking is always good in systems work, for the best of us err, forget, or don't quite get the full story. And the man who will eventually be responsible for the work is one of the most useful checkers. So let's put him early in a position where he can grasp the goings-on and recognize the weak spots.

In conclusion then, let's not burden the systems man with responsibilities that will eventually need to be transferred to others and that usually ought to be transferred as soon as possible, let's help him keep out of company politics, let's use him as the wide-ranging specialist he ought to be, and let's use all others in the organization in the most valuable fashion. In so doing, we will be coming up with more workable and integrated systems, and we will be generating them from all levels of a systems-conscious organization. We will have spread and simplified the systems function, have buried the cleavage between systems men and those many others who think they too have good ideas and a knowledge of their jobs. And we will have a more satisfied and productive organization.

Yours truly,

WILLIAM L. BOYD

Electronic Business Machines —

Today — Tomorrow

by Milton E. Mengel

The Burroughs Corp., one of the giants in office machine manufacturing, holds forth on the future of high speed electronic computers in the field of general business through its director of product planning. Mr. Mengel presented this paper at the Third Annual Conference of SPA's San Francisco Chapter in April.

I PROPOSE to discuss in general terms our product philosophy at Burroughs. I will be specific where our developments are far enough along to permit mention.

To begin with, I am assuming that the word "electronic" need not be taken too literally and that what was intended was "integrated." Some people use the word "electronic" in the belief that "push button" operation of integrated business data processing machines can only be accomplished with vacuum tubes or their substitutes. To be sure, electronic and magnetic techniques will undoubtedly be big factors in the machines of tomorrow; but economical and efficient operation by whatever means will I am sure be equally acceptable—be they electronic, magnetic or atomic.

The situation to date can probably be summarized by saying that a number of scientific computers have been built, and that electronics has been used to improve the operation of existing types of machines. If we include special business problems of the same complexity as those scientific problems generally considered appropriate for electronic computers, then it probably is fair to call electronic computers business machines.

Here again we should define our terms. As used here, an electronic computer is an electronic device for adding, subtracting, multiplying and dividing at relatively high speed in the solution of complex problems through a prearranged program which directs the machine through the entire required operation. It is intended that this separate the electronic *calculators* made by the two punched card manufacturers from the digital *computers* of more sophisticated design. If the definition is controversial, it is hoped that the separation is not.

We think it made a great deal of sense for the punched card people to apply electronic techniques to existing

types of machines—to replace mechanical or rather electro-mechanical mechanisms with electronic techniques. We think it makes sense to augment such equipment with magnetic or other forms of storage so that the number of steps required in the processing of the data may be reduced. We think this is a sensible form of integration.

Again we need to define terms. The looked-for "push button" office would employ a completely integrated device into one end of which one would dump the raw data and out of the other end of which would come the finished records such as invoices, statements, pay checks, reports of all kinds, etc. This is a complete integration.

To build such a machine or system, one needs to solve a good many problems; or, at least, we think so. Here is the way we look at it.

Make-Ready Costs

Perhaps the largest area of clerical cost is the area of "make ready"; that process of taking raw business data and organizing it for efficient handling in a system. In a punched card system it means key punching or marking cards for mark sensing. In at least one electronic system it means tapping typewriter keys to record on magnetic tape. In most systems this requires by far the greatest proportion of the people required for all operations. Surely no one would dispute the fact that a solution to the "make ready" problem would indeed be a major contribution to the ultimate "push button" office.

Early in our research effort we decided that this area was so important that a large part of our budget was assigned to developing equipment and techniques that would either reduce raw data to coded form for automatic processing, or would produce coded media as a by-product of some necessary manual operation. Typical of the devices which have and will result from this effort are an accounting machine with punched paper tape attachment and a device which automatically reads numbers and automatically punches a card to correspond.

Our accounting machines with punched paper tape as well as printed output permit the automatic processing, at a central point, of data originating at branch or other remote locations. One example of its use might be where stock ledgers are maintained at each of a number of warehouses and where it is also desired to maintain a central control of the stock in these separate warehouses.

An accounting machine with punched paper tape output would be used to maintain a historical record of stock movements by items. The posting to these ledgers would, in addition to maintaining history records, produce a punched tape on which the transaction and/or balances would automatically be recorded. This tape could then either be mailed to headquarters or could be transmitted by wire.

Another application of the same kind of equipment is in a savings bank where it is desired to make an entry in a customer's passbook in the shortest possible time, and at the same time record the information so that it may later be taken into the books of account. Here the tape punch records the information as a by-product of the passbook entry. Subsequently, the tape may be used to create cards where a punched card system is used. Later, other central processing equipment will be available for this work.

In thinking of your own problems, I am sure you will see many places where you would wish to combine the many advantages of accounting machines and other recording devices with the advantages of central processing equipment. Punched paper tape is one way of transmitting information between kinds of machines.

Under certain conditions, the information which comes into a system can be determined in advance and can therefore be prepared for processing in advance. For instance, the utility bill sent to a customer is usually paid for as issued. Therefore, if the stub is properly coded, it can be processed as a cash receipt when received by the utility without the need for manual transcription.

The use of pre-punched cards, made up in quantities for like items, is well known to all of you, I am sure. This principle has been employed by at least two makers of garment tag marking machines. These machines prepare garment tags which are not only printed to identify the merchandise, but also punch in a code which can be read into data processing systems at the time of sale.

Large Areas Untouched

A great deal has been done to reduce the amount of manual transcription through the use of coded documents or through the use of coded media prepared as a by-product of necessary manual operations. Despite all the work that has been done with coded documents and with encoding attachments to peripheral equipment, there still exist large untouched "make ready" areas.

For instance, some documents, for legal reasons or otherwise, cannot be altered by the addition of visible coded information. A good example might be a travelers check which had been established in its present form as an acceptable medium of exchange. To alter the appearance through a visible coding might lessen its acceptability. The problem of reading significant uncoded information from such a document was given to us a few years ago.

We solved the problem and have built a device which will automatically read serial numbers from these travelers checks and punch a corresponding card. The equipment is entirely automatic. The operator merely places a stack of travelers checks in the hopper, presses a button, and cards with corresponding serial numbers are punched automatically at the rate of 7200 per hour.

Obviously, if such a device can read directly uncoded information on a document such as a travelers check, it can read any similar uncoded information on other documents. This may provide a means for automatically processing, at a central point, information which originates in places where the cost of producing coded information cannot be justified.

It seems clear to us that there will be many situations using a number of remote points each with volume too small to justify—let's say a $1500 attachment to an otherwise necessary business machine. Yet, if central equipment capable of reading uncoded information were to cost, let's say $30,000, then the added cost per peripheral point would be only $300 if there were 100 such points and less if there were more, and probably could be justified.

Tough Problem

The real tough problem remaining is the one where documents, such as checks, and the information they contain must remain together for one reason or another. The variety of sizes and thicknesses makes the automatic handling of the paper difficult but not necessarily impossible.

To summarize the "make ready" area, let us say that numerous kinds of coded documents are in existence or soon will be, and that equipment to read such documents has been or will soon be developed. Let us say too that the preparation of coded media as a by-product of essential manual operations is either already possible or soon will be. Let us say finally that good progress is being made to reduce to automatic or semi-automatic operations those areas which have not yet been solved.

If automatic input to a system can be attained by one or more of the methods described above, then I guess the next thing to consider is, "What kind of data processing system?"

We have never felt that electronic scientific computers, as they have been and still are constituted, provided a good base from which to develop a business data processing machine. We felt so strongly about it that we never did offer a scientific computer for sale, although we have built several we are mighty proud of. First we built one for our own use in our research laboratory. Later we built one for Wayne University in Detroit. These machines are similar and are unique in that they employ unit construction. The units are the basic flip-flops, gates, coincidence detectors, etc., assembled as required to provide the desired characteristics. This unit construction was employed because we wanted to be able to incorporate new developments as they became available.

These computers have been of great help to us in testing various components which hopefully might be used in future machines especially suited to business data processing. We have resisted the temptation to go into the scientific computer business because we feel this would divert our efforts from our ultimate goal of building a better business machine.

Why do we feel that present day electronic computers are not good bases from which to build electronic business data processing? First, we feel that business problems generally are not arithmetically complex. Therefore we feel that the speed of computation available in electronic computers is generally in excess of that required for ordinary business calculations. Secondly, we feel that even the simplest of business problems requires access to a tremendous amount of information.

For instance, let us suppose we wish to record payments of utility bills. Our record of unpaid bills is in customer number order. The payments, coded by account number, are in random order as received. The problem is to match the random payments against the unpaid accounts.

One way to do this is to take each payment in turn and search through the unpaid file until the matching account is found. Another way is to first sequence the payments so that they are in the same order as the file. The first way is the one recommended by some who feel that the speed of magnetic drums or other magnetic devices is such that random look-up is practical.

Our feeling is that the incoming information is either on a coded document or should be. In the case of the coded utility payment stub, we feel that it would be much less expensive to sequence the stubs and match them with the file than to have a random look-up. We think this is particularly true when one considers the cost of either the very large drum or the several small drums needed to maintain the needed information on several hundred thousand customers.

One Objection

An objection which has been raised against the method just described is that it requires people to keep loading the card sorter. It has been claimed that a tape sorter would eliminate such labor. We agree that as magnetic and electronic techniques advance, it may be possible to read coded documents and record the information from them on magnetic tape and then process the tape to sequence the information.

While in theory it sounds like it would be easy to zip magnetic tape back and forth and thus sort information quickly and automatically, it is a rather tough problem and here is why. A good many schemes have been advanced, but I believe the magnitude of the problem will be obvious if you will just visualize with me one scheme which parallels punched card sorting.

Given a tape with random information, we can read from it onto ten other tapes, one tape for each digit in

the unit position on which we will sort first. Bear in mind that as we sort to the separate tapes, we transfer *all* the information. This differs from a card sort in that all of the information goes along automatically and unchanged with the digit sort. With tape sorting each transfer of information, an error in transcribing is possible.

Having sorted on the last digit, we now must gather up the information just as we gather up cards from a card sorter. With tapes, we read all the information from the ten tapes back to a single tape so that we may now sort by the second digit of the number, and we repeat this process until we have completed our sort.

While a tape system using perhaps as few as four reels could be mechanized so that the operation could be completely automatic from the insertion of the coded documents to the output of coded media in sequence form, it cannot yet be done efficiently or economically enough to compete with conventional methods. In fact it would probably be no more costly to build a completely automatic card sorting machine where the card re-circulated through the sorter after each digit sort without the need for human intervention.

Exceptions Are the Rule

Another reason why we feel that electronic computers are unsuited as business machines is because most business problems have many more exceptions than are found in scientific computation. It is true that where rules are set down for business practice they can be programmed so that every contingency can be taken care of automatically. Each exception increases the complexity of the program and adds correspondingly to the equipment's cost. Now if the exceptions are numerous and the number of each is small it does make the program cost for the exception much higher than the human judgment it is replacing. In other words, the old codger at the end desk who knows all the exceptions may be the cheapest way to do the job.

I didn't make the specific point, but I am sure it is obvious that an integrated system must handle the exceptions as they occur, as it could not tolerate the discarding of partially processed information at various points in the systems, and it could not take the manually manipulated exceptions and patch them in their proper place in the output.

So, to sum up, our reasons for not considering present types of electronic computers for processing business data are: (1) electronic speeds too costly and not needed generally, (2) inadequate external storage, and (3) high cost of program and control equipment for little used exceptions.

Now let us assume that we had automatic input in an automatic data processing system. What would we do with the results of our computations and manipulations? The results of such manipulations are usually printed on invoices, statements, reports and the like. It is a peculiarity of business systems that there is a large amount of output data resulting from a large amount of input data. This is in contrast to scientific and engineering data processing where there is a relatively small amount of input data, a large amount of processing, and a relatively small amount of output.

Obviously, with output being such an important part of the over-all problem, it does deserve a proportionate share of the interest in the over-all system. While the weight of the output varies by kinds of business, many people have told us that they deemed the problem of creating documents to be equally or more costly in clerical labor than the processing of the data. In other words, properly designed document producing equipment may save you more money than electronic computers.

Consider again the case of the utility company. Let us suppose it marks cards for meter readings and that these cards already have the previous readings in them. Such cards could be processed by any number of punched card techniques to contain in coded form all needed billing information except the customer's name and address.

Those of you who are familiar with utility problems are aware of the many steps required to print a post card bill with the accounting information on one side and the customer's name and address on the other, and with the account number and amount punched in the stub. In addition to printing a bill it usually is desirable to print and punch a card to be used for making the next reading.

As I recall, eight or more separate steps are now required to produce the documents just mentioned. Several different pieces of equipment are needed to do the job. Labor is required to move the documents from one step in the operation to the other. Labor is required to man the various machines required.

New Burroughs Machine

We felt that, with document production representing so large a part of the clerical effort, it made sense for us to spend a considerable part of our research effort for integrated document producing equipment. The Control Industry Company, a Burroughs subsidiary, has developed a printer which reads punched cards at the rate of 1000 per minute and printed premium notices at the rate of 900 lines per minute, or at the rate of 225 notices per minute. A novel feature of this machine is its ability to read information from two stacks of cards so that names and addresses may be read from one stack while accounting information is read from the other stack. This feature eliminates the need for merging cards and subsequently separating them as is now required.

In its final form, the equipment will permit punching a card like a post card utility bill at the same time it is

being printed. This will permit the merging of eight previously required operations into one! To print and punch a post card bill and to print and punch an advance meter reading card requires that two units be operated in tandem. Up to three units may be operated simultaneously to print and/or punch three separate documents.

Of interest, too, may be the fact that this high speed printing is accomplished by forming the characters with dots from a 5x7 matrix. This makes it possible to print any kind of a character which can be formed by the 35 wires in the matrix. It also means that the character can be printed in reverse, a feature used in printing the name and address on the reverse side of a post card bill, while in the same run printing accounting information on the front side.

We feel we are evolving input equipment which currently may be used as input to existing equipment but which later will just as efficiently be input to other types of central processing equipment now under development. The printing and punching equipment now being readied for the market is also designed for use with existing systems, but will be equally efficient with other processing systems under development.

Whether or not the three areas of make ready, data manipulation, and output are ultimately combined into one grand piece of machinery is problematic. We feel, like many others, that the slight additional clerical savings which complete integration might bring over the suggested "area" integration concept would be more than offset by the considerable extra cost for programming and control equipment and the extra cost of especially trained programmers.

Perhaps this is another way of saying that an expensive piece of electronic equipment will be hard to justify, even in large concerns well able to afford the luxury. For those who have mass data handling problems, integration by areas is available in the near term—why not take advantage of it, and save money instead of waiting for the completely integrated systems which seem so tantalizingly just around the corner.

For those whose volume does not justify the high speed described here, there is equipment coming along to similarly solve your problems. Let me say that you should not overlook the possible present savings with currently available equipment while waiting for these machines of tomorrow—or the day after. **s/p/a**

Book Review

Business Management Handbook
Edited by J. K. Lasser. McGraw-Hill Book Co. New York 36, 809 pp., $8.50
Reviewed by Richard W. Pomeroy.

This book is a compendium of information essential to the conduct of a successful business, and presents in one volume the material heretofore available only in the 24-volume McGraw-Hill Course for Business Executives. It is a complete "How-to" book for the business executive and covers every area of executive operations, explaining how to approach each task and how to function efficiently and effectively.

The late Mr. Lasser, one of the nation's best-known authorities, edited this encyclopedic volume of practical business information. Each of the contributing writers is a specialist in the field he covers. Material from the Executive Course has been brought up to date and streamlined for easier reference. The book is rich in charts, outlines, checklists and other devices which present basic material in readily available form, and a comprehensive index has been added to facilitate reference.

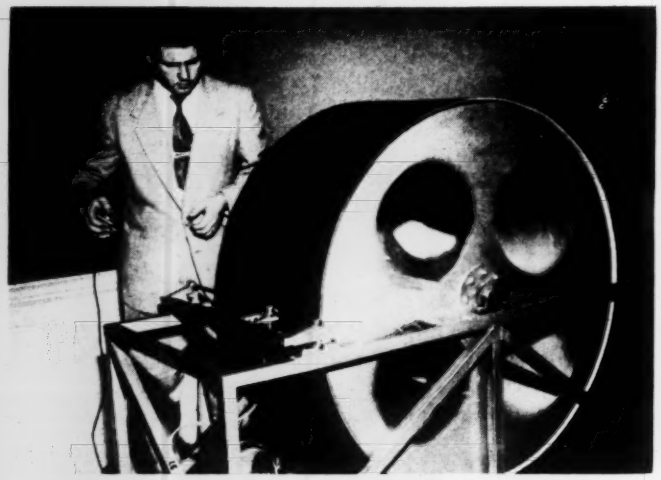
Aside from its comprehensiveness, the most valuable asset of the book is the practicality of the information presented. Wherever possible, concrete statements and practical examples supplement generalities. Typical of such statements is a chart indicating the percentage of gross sales any given type of business can justly afford to pay for rent.

The book is divided roughly into two phases of the subject matter. The first is concerned with getting a business started—such things as corporate formation, financing, location, buying and selling businesses and marketing. The second deals with the control of business —the accounting, distribution and cost functions, budgeting, internal controls, etc. Each of the 20 chapters is complete in itself.

The chapter on "How to Design Systems for Internal Control" is well-written and thorough. It discusses at some length the mechanics of each of the five areas of operations which require internal checking: inventories, expenses, payrolls, cash, and special assets. An excellent chapter on the control of paper work is followed by an extensive related bibliography.

Properly used, this book can make a large and lasting contribution toward professional advancement; it can serve as a valuable supplement to the broad range of experience which characterizes the activity of systems personnel.

WORTH READING, located on page 17, reviews selected articles from the management press.



Four feet in diameter and 21 inches wide, the magnetic memory drum can store 400,000 transactions, or a total of over 1,250,000 digits. Drum will also be used to store other statistical data.

From computer—the workhorse in electronic tolls accounting setup—figures are fed to automatic typewriter, which translates them into reports. Programming board at left extracts information from drum.

Electronic Data Processing

by J. Henry McCall

THERE is hardly an organization in the country that doesn't have a data processing problem. Data processing, as such, is the use of original data and its many reuses in order to furnish management with current control data on which to base operating decisions and planning policies. Perhaps the problem is payroll, or inventory, or production control, or any function requiring mountainous amounts of paper and clerical time. In inventory, there is the planning, scheduling, ordering, receipt, issuance, pricing, accounting, control and on and on. In payroll, there are the additions and removals, the changes in salary rates, and computations of half pay, time and a half and double time pay, numerous deductions, net pay, monthly, quarterly and annual reports, etc.

The Port of New York Authority* has a similar problem. Theirs is not an inventory or payroll problem but the processing of data representing revenue collections.

Tolls collection is a complex recording, accounting and statistical function. For all intents and purposes, it encompasses the same problems encountered by manufacturers in the control of inventory.

To handle this problem, which is now being done clerically with the aid of electro-mechanical register equipment, the Authority has contracted for a completely integrated electronic system to handle tolls recording and accounting at their six vehicular crossings; the Holland and Lincoln Tunnels and George Washington Bridge crossing the Hudson River; and Bayonne and Goethals Bridges and Outerbridge Crossing connecting Staten Island with New Jersey.

*The Port Authority is a self-supporting agency of the states of New York and New Jersey. Operating without cost to the general taxpayer, it is charged with two basic jobs under the provisions of the 1921 Treaty, which created it—the development and operation of transportation and terminal facilities in the Port District, an area within a 25-mile radius of the Statue of Liberty, and the promotion and protection of commerce in the port.

The Port Authority functions as a self-supporting public corporation with operating policies patterned on sound business principles and practices. The Executive Director is the management head of the Authority and is responsible to the Board of twelve Commissioners. These Commissioners, six of whom are appointed by the Governor of New Jersey and six by the Governor of New York, serve without compensation for terms of six years.

Briefly, the tolls function accounts for about: 80,000,000 cash and ticket transactions, $40,000,000 gross revenues, 66 toll categories, 83 toll lanes—numbering from 6 at Outerbridge Crossing to 26 at the George Washington Bridge, 500 toll collectors working around-the-clock although any of the Authority's 1000 Traffic Officers are available for tolls collection duties, 24 time intervals and 2 directions of traffic.

All of the above data by itself and in combination is the Port Authority's data processing problem. The information required results in accounting reports from an audit and control standpoint, statistics from an operating and planning, research and development standpoint.

Laying the Cornerstone

Electronics developed its roots in the Authority back in 1949 when the writer undertook a comprehensive research program to obtain answers as to what part electronics might play in creating more effective management tools. Naturally, before electronics could be thought of as an actual application to any of the Authority's functions, it was necessary that an all inclusive look be taken at the many basic clerical and statistical functions being performed throughout the organization. These functions had to be looked at as a whole rather than by the pieces performed by a single department or division.

At the start of this undertaking, the Authority was interested in those particular operations or functions which required the employment of many people and/or those operations involving production units on either a centralized or decentralized basis. It was determined that the most applicable area of research for such a program was with tolls recording and accounting.

Critical analysis of the existing procedures enabled the Authority, at that time, to simplify and further mechanize existing procedures—many statistical reports prepared manually were put on tabulating equipment, the reports completed by the toll collectors were simplified and streamlined as well as the complete tolls collection operation. This alone was not the complete answer. Electronic data processing equipment, however, could be.

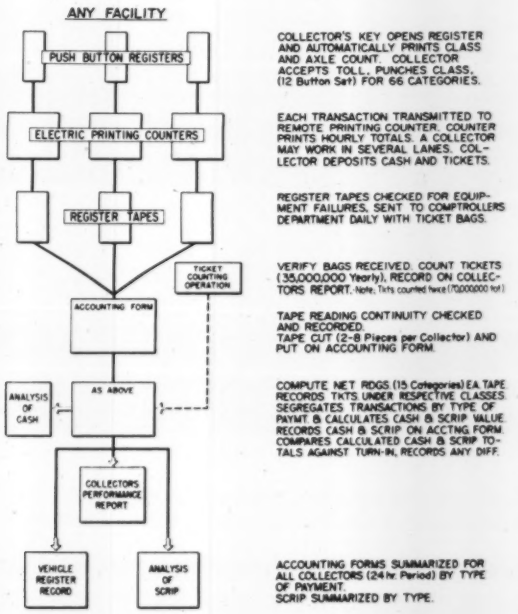
Therefore, having determined that the Authority had a measurable area of applicability, many manufacturers were contacted and they, in turn, working with the Port Authority developed proposed electronic tolls accounting systems. Many presented proposals which were functionally suitable and could be economically justified.

Analysis of Proposals

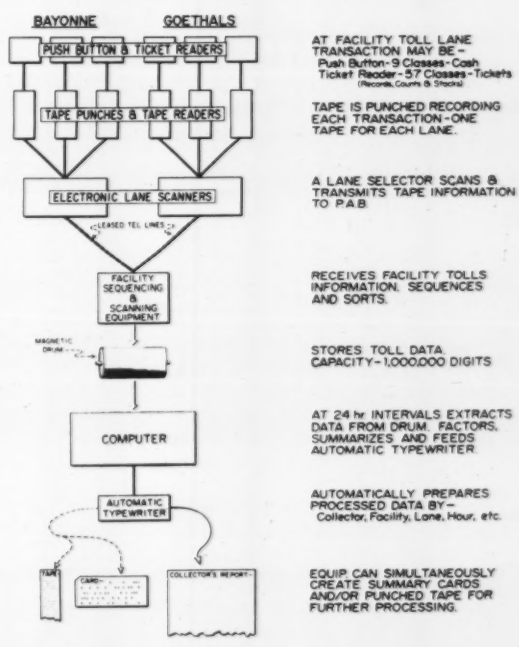
Eliminating those proposals which could not be economically justified and which appeared functionally unsuitable, an intensive analysis was made of those remaining to determine which one better suited the needs of the Authority. As in any analysis made on such equipment, the following were among the many factors used as the yardstick in determining which proposal best suited the established electronics program:

Simplicity	Working requirements and volume
Performance	Spare parts and service availability
Reliability	Machine language paper
Flexibility	Investment and economic justification
Maintenance	

PRESENT SYSTEM


ANY FACILITY
PUSH BUTTON REGISTERS
ELECTRIC PRINTING COUNTERS
REGISTER TAPES
TICKET COUNTING OPERATION
ACCOUNTING FORM
ANALYSIS OF CASH
AS ABOVE
COLLECTORS PERFORMANCE REPORT
VEHICLE REGISTER RECORD
ANALYSIS OF SCRIP
COLLECTOR'S KEY OPENS REGISTER AND AUTOMATICALLY PRINTS CLASS AND AXLE COUNT. COLLECTOR ACCEPTS TOLL, PUNCHES CLASS, (12 Button Set) FOR 66 CATEGORIES.
EACH TRANSACTION TRANSMITTED TO REMOTE PRINTING COUNTER. COUNTER PRINTS HOURLY TOTALS. A COLLECTOR MAY WORK IN SEVERAL LANES. COLLECTOR DEPOSITS CASH AND TICKETS.
REGISTER TAPES CHECKED FOR EQUIPMENT FAILURES, SENT TO COMPTROLLERS DEPARTMENT DAILY WITH TICKET BAGS.
VERIFY BAGS RECEIVED. COUNT TICKETS (35,000,000 Yearly). RECORD ON COLLECTORS REPORT. Note: Tkts counted twice (70,000,000 tot)
TAPE READING CONTINUITY CHECKED AND RECORDED.
TAPE CUT (2-8 Pieces per Collector) AND PUT ON ACCOUNTING FORM.
COMPUTE NET RDGS (15 Categories) EA TAPE RECORDS TKTS UNDER RESPECTIVE CLASSES. SEGREGATES TRANSACTIONS BY TYPE OF PAYMT & CALCULATES CASH & SCRIP VALUE. RECORDS CASH & SCRIP ON ACCTNG FORM. COMPARES CALCULATED CASH & SCRIP TOTALS AGAINST TURN-IN, RECORDS ANY DIFF.
ACCOUNTING FORMS SUMMARIZED FOR ALL COLLECTORS (24 hr. Period) BY TYPE OF PAYMENT.
SCRIP SUMMARIZED BY TYPE.

PROPOSED SYSTEM


BAYONNE
GOETHALS
PUSH BUTTON & TICKET READERS
TAPE PUNCHES & TAPE READERS
ELECTRONIC LANE SCANNERS
LEASED TEL LINES
FACILITY SEQUENCING & SCANNING EQUIPMENT
MAGNETIC DRUM
COMPUTER
AUTOMATIC TYPEWRITER
TAPE
CARD
COLLECTOR'S REPORT
AT FACILITY TOLL LANE TRANSACTION MAY BE – Push Button - 9 Classes - Cash Ticket Reader - 57 Classes - Tickets (Records, Counts & Stocks)
TAPE IS PUNCHED RECORDING EACH TRANSACTION - ONE TAPE FOR EACH LANE.
A LANE SELECTOR SCANS & TRANSMITS TAPE INFORMATION TO P.A.B.
RECEIVES FACILITY TOLLS INFORMATION, SEQUENCES AND SORTS.
STORES TOLL DATA CAPACITY - 1,000,000 DIGITS
AT 24 hr. INTERVALS EXTRACTS DATA FROM DRUM, FACTORS, SUMMARIZES AND FEEDS AUTOMATIC TYPEWRITER.
AUTOMATICALLY PREPARES PROCESSED DATA BY – Collector, Facility, Lane, Hour, etc.
EQUIP CAN SIMULTANEOUSLY CREATE SUMMARY CARDS AND/OR PUNCHED TAPE FOR FURTHER PROCESSING.

Following the review, it was agreed by all interested staff members that the proposal that best suited the Authority's needs would be the one selected.

Present System

Briefly, the present system operates as follows: At the start of the tour, the traffic officer assigned to toll collections is issued an identifying key. The key number is recorded by him on all reports that he completes and is used later in accounting for this operation. On entering the toll booth, the collector inserts the key which energizes the equipment. Every time the key is inserted or withdrawn, the status of that particular lane is recorded on a register tape in remote printing counters at the facility headquarters. As a vehicle approaches the toll booth it crosses a treadle in the roadway which counts vehicles, by axle, i.e., 2 axles—passenger car or 3 axles—a trailer truck. On receipt of the toll, the collector records the transaction by depressing the proper classification button or buttons, depending upon the transaction. If the transaction is a ticket, the collector voids the ticket by electric time stamp and places the ticket in his ticket box. Simultaneously, with the pushing of the button, the transaction is recorded in the register and at selected hours recorded on the register tape.

During a tour of duty, a collector may work in several lanes. All his tapes for that tour are identified by the key number which is recorded on the tape associated with each lane and he, in turn, records all the lanes worked on his "Collector's Report." The latter action serves as a check when his transactions are being accounted for in the main office. At the end of tour, the collector deposits all cash and tickets collected into separate facility depositories. At prescribed times, the funds are forwarded to the bank by armored service and the tickets to the Comptroller's Department. Daily the register tapes are removed from the register equipment and sent to the Comptroller's Department.

The Comptroller's Department receives approximately 180 containers of tickets each day for checking. After checking against the manifest, each container is opened, the tickets removed and counted twice. The clerk counting the tickets (mechanically) then records the number of all the different types of tickets collected. At the same time, the register tapes are stapled to individual collector's accounting forms. When completed the accounting forms are forwarded to comptometer operators who, from opening and closing balances, calculate transactions by class and compute the registered and calculated axles (by classification). Transaction figures are converted into dollars and checked against the collectors' cash deposit slip. The ticket transactions are checked against the collector's ticket report.

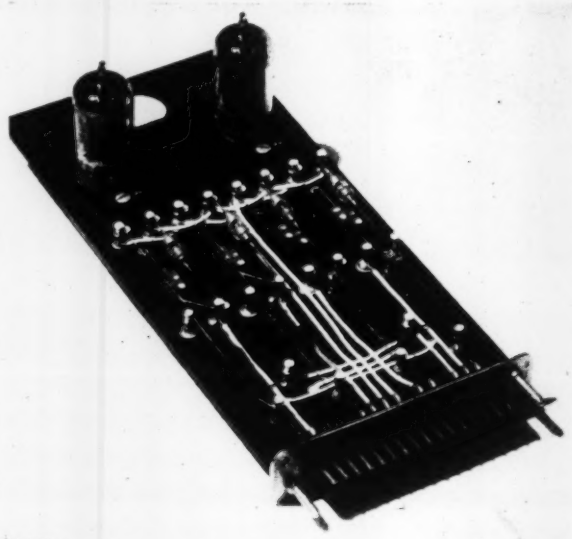
Daily an analysis of each collector's toll transactions is posted to a collector's performance report. All reports for all crossings are available approximately three days after the end of the 24-hour period being checked. From the statistics gathered, a vehicle register record by facility is prepared which lists the transactions by classification and type of payment. A third report is the analysis of the scrip and tickets lifted at each facility. Other reports are then developed by combining the information shown on the register tapes as required.

Electronicized Tolls Recording and Accounting

Briefly, the electronic system will function as follows: each traffic officer will be permanently assigned an identifying key by means of which toll booth equipment is put in operation and the collector's transactions during his tour of duty are identified. On receipt of a cash toll, he will depress the appropriate classification button on the keyboard, on receipt of a ticket which will be prepunched with a classification code, the collector will insert the ticket in a ticket reading device which, by reading the coded punches, will automatically register the type of ticket and the vehicle classification.

The pulses created by the ticket reader or the keyboard action will be automatically produced into punched paper tape in a remote location at the facility headquarters. The punched tape, by lane, will then be read and transmitted over leased telephone circuits to the Port Authority Building where the data will be stored on a high capacity magnetic drum storage unit until required for processing into completed reports. Daily, transactions accounted for will be balanced against cash and ticket receipts by individual collector. The reports will be prepared directly by a flexo-

Nearly 300 components similar to this one make up central audit unit. Each is a maze of wires; some have two vacuum tubes, others do not.



writer but the system is so designed that other means of output are available, such as punched tape, magnetic tape and 407 type printer.

In processing the aforementioned data, the following major components make up the complete system:

Collector Identifier

Each traffic officer will be permanently assigned a key which will identify all transactions recorded by him in *any* lane at *any* facility. As in the old system, the treadle is in continuous operation. However, the key will energize the remaining toll booth equipment as well as all other equipment associated with the toll booth.

When removing the key, the collector must depress one of two buttons—one (relief) means he will continue collecting tolls elsewhere during his tour, the second (end of tour) means he is ending his tour of duty. The purpose of the buttons is to tell the central equipment when a final report can be prepared.

Input Keyboard

A ten-button keyboard has been designed to record cash transactions. The collector will never have to depress two buttons as in the old system. Also the number of registrations via the keyboard has been reduced by approximately 50% since the collector will not have to register ticket transactions. The keyboard is a pluggable unit, light in weight and permits rapid replacement by a spare unit in case of failure. This unitized construction is used throughout the system.

On receipt of a cash toll, the collector depresses the proper classification button and the transaction is immediately recorded. At the same time, the action of the keyboard will activate the existing overhead and sidewalk indicators and correlate axle counts from the treadle with registered classifications.

Ticket Reader

Nine of the 66 toll categories are cash, the remaining 57 are tickets and represent approximately one-half the total transactions. To register the tickets, the ticket reader has been designed to accept all type tickets, scrip and passes which will automatically register the proper class when the ticket is inserted into the slot eliminating the need for classifying the vehicle via the keyboard as in the old system. However, the mechanism is so designed and programmed that it will not accept tickets invalid for a particular crossing or those which may have been improvised, cancelled or spoiled.

When inserted, the prepunched ticket will automatically activate the overhead and sidewalk indicators as well as transmit the transaction for recording—a complete interlock system between all push buttons and the ticket reader is provided to completely eliminate simultaneous action. After reading the ticket, the reader will automatically void the ticket making it unusable a second time.

J. HENRY McCALL was porcedure manager of the Port of New York Authority from 1949 until July of this year. He became manager of Electronics Research Division for the Port Authority in August, charged with research, planning development and installation of all electronic programs. A graduate of the Bentley School of Accounting and Finance and Boston University, Mr. McCall did procedures and accounting work for the J. W. Greer Co., and the DeLaval Steam Turbine Co., Trenton, N. J. before joining the Port Authority staff.

Automatic Tape Punching, Reading Mechanism

The *transactions* and *treadle count* being transmitted from the toll lane are received in the facility headquarters on a tape punching and reading unit—there being one for each lane. The punching speed will be capable of handling 1000 transactions per hour, more than twice the estimated traffic per lane.

A transaction will consist of punching a combination of positions in the tape. A transaction will contain information relative to any one of 66 classes, axle count, lane identification, toll collector identification, time information, direction, etc.

Reader Selector

A reader selector is an electronic scanning unit capable of sequentially accepting inputs from the tape readers for each lane at the facility. The information converted to proper language is then transmitted from facilities being from 2 to 20 miles distant, over leased telephone circuits to the Port Authority Building. The reader selector is capable of sequentially receiving a minimum of 45,000 transactions, the maximum capacity for 45 toll lanes. Presently the highest number of toll lanes in operation is the 26 at the George Washington Bridge.

Input Console

At the Port Authority Building, a standard type reperforator will translate the electric impulses received back into punched tape. An input console—one for each facility—will then receive the information and control its entry into the high capacity magnetic drum storage unit. (*Continued on next page*)

High Capacity Magnetic Drum Storage Unit

The memory drum will be capable of retaining in storage 1,300,000 decimal digits, or 5,000,000 binary bits, any of which are available as required in measurable milliseconds. Approximately one quarter of the capacity of the drum will be required for the tolls recording and accounting function. The balance of the drum is available for other functions such as payroll, cost accounting, statistics, etc. Additional drums can be tied into the system should additional applications require increased storage capacity.

Computer

The computer is general purpose and for this system will be directly tied into the output unit, a Flexowriter, the high capacity memory drum and the control unit.

The computer has been so designed as to be completely compatible with multiple type input and output such as 80 or 90-column tabulating cards, magnetic tape, punched tape and printed reports.

In any electronic system so integrated, numerous alarms and checks must exist in order that complete control is maintained over the information as it is being processed. This is true of the Authority's installation. For example, if a toll registration is incorrectly recorded for any reason whatsoever, this information will be immediately known by the individual in charge or if any information transmitted to the main office, or information which is processed in the system in the main office is incorrect, the individual operating the equipment will immediately know of the error.

The unit is being designed and programmed to produce all of the reports which the Authority now prepares manually and in addition, the equipment can be programmed, or the punched tapes can be rerun, to produce additional statistical traffic reports demonstrating the trend of traffic which management requires for planning.

In addition to the above, the Authority stands to gain more accurate recording of transactions thereby reducing toll collectors' errors and improving their performance: many hours required to count the tickets collected will be eliminated; maintenance will be made easier and quicker because of unitized components; and additional workloads, created by additional facilities, will require no additional personnel. It is estimated that the reduction in personnel, space and office equipment costs will produce immediate savings of approximately $50,000 annually to the Authority and will increase as the machine workload increases. It is estimated that it will be approximately one million dollars in five years.

The Authority intends to obtain maximum use of the equipment being purchased. A program of research and application (including payroll, expense distribution, revenue accounting, cost accounting, statements, development statistics, etc.) is presently being developed with installation dates running through 1959. **s/p/a**

Management's Stake in Systems

First of a series by Leslie Matthies

ANY OPERATION in your place that uses more people, more space, more equipment, or more supplies than needed, is "oversize".

If you have just one oversize operation it sets up a chain reaction that runs like a prairie fire through your entire organization. More people take up more space. They need more machines, more desks, more supplies.

Consider other effects: more employee parking, more payroll activity, more forms, more supervisors, more janitor service. Don't overlook the increased insurance payments, the greater taxes. Communications and mail loads go up. There will be more work in such services as duplicating, maintenance. You'll need more training effort.

Purely as an example, let's say your purchasing operation is oversize. You find it costs you $100,000 to operate it for a year. With the right system, it may cost you only $66,000.

Nice saving—$34,000—if you can get it. You should put that 34 grand where it will do some good. Lower your prices, declare another dividend, or plough some into research or development work.

Important as that $34,000 saving may be, it is really only the beginning. Here's why:

If you have *one* oversize operation, you also have oversize operations *all over the place!*

In our purchasing example you were 50% oversize. You had 25 people but with a good system you only needed 17. Those extra 8 people had to be hired, didn't they?

What does it cost you to hire people? Did the oversize condition have any effect on your personnel department's workload? Sure it did.

Is your cost picture in balance? Are you able to meet and beat competition on the pricing front? Do you earn the right profit margin on your vlume of business?

Did you say: "How can I tell if we have an oversize operation?"

If you will bear with me for the next eight issues, I'll try to tell you how you can find out. Each part of the story will be brief, like this one. **s/p/a**

Worth Reading —

a selection of articles from the management press this year

SYSTEMS—MASTER OR SERVANT?

To some executives, "red tape" and "system" are synonymous. To others, "chaotic" and "unsystematic" have practically the same meaning.

The first of these widely opposed schools of thought includes managers who recoil from systematic actions as they would from an adder. To them, anything that requires a consistent approach to the solution of similar problems or to getting required work done is anathema.

Those who adhere to the second school of thought cannot face activities that require the slightest deviation from the straight and narrow path of the standard practice manual. They choose to ignore the exception, insisting that every procedure fit into a rigidly predetermined course of action.

Is there a satisfactory middle ground between these two viewpoints? Logic and successful experience point to an affirmative answer.

A system can be thought of as a means of assuring order in activities undertaken to achieve certain objectives. Since systems are the result of analysis, forecasting, and planning, they require for their conception a much higher order of intelligence than that used in managing by hunch and expedience.—SAMUEL L. H. BURK. *Systems Magazine*, Vol. XVIII, No. 1.

"Combined Billing and Accounts Receivable"—L. J. Lehan, *Management Methods*, May 1954.

About 100 hours a week were required to process 65 invoices daily averaging 6 to 8 items, and to post accounts receivable, cash receipts, and salesmen's commissions. Use of a bookkeeping machine has reduced to 60 the weekly hours required for the preparation. Furthermore, discrepancies cannot occur between entries on invoices, customer's statements, accounts receivable cards and the sales journal because they are all posted at the same time and "proved" by the machine.

"GE and Univac"—Roddy F. Osborn, *Harvard Business Review*, July-Aug. 1954

The author, manager of the Business Procedures Section at GE's Louisville Plant, describes his experiences with an electronics installation during the past two years. Concludes with suggestions for an electronics program:

1. Employ a competent consultant.
2. Limit initial areas of application.
3. Choose areas of large routine clerical effort and where tab equipment is used.
4. Get a system—not just a computer.
5. Select the right person to head the program and make capable systems and procedures people available for the required time.
6. Sell and interest management and supervision on the possibilities of improving operation through long range planning.

"Self Service Parking for Your Employees"—*Management Methods*, May 1954.

Cards issued to employees are used to actuate the opening of a gate at the entrance to a parking field. The gate is closed automatically by a pedal depressed when the car passes through. The need for guards to maintain control has been eliminated.

"Operation: Switch"—Benno Bordiga, *Management Methods*, May 1954.

Nine department heads were assigned for a day or two to other departments in order to promote harmonious relations by putting them "in the other fellow's shoes". A second objective was to get suggestions for improvement of operations. One outcome was a thorough house cleaning of all departments prior to the switch. Work simplification ideas resulted in an estimated $50,000 annual saving. The experience broadened the participant's understanding of problems faced by others.

"Sales Analysis is Faster on Machines"—Alfred O. P. Leubert, *The Office*, July 1954.

Weekly figures for 100 salesmen with 12 different products are calculated on a cash register type machine from invoices. Totals are printed directly on a printed spirit master ready for reproduction. Man-days required for the operation have been halved.

"Simplified Disbursement of Salesmen's Expenses"—*The Office*, July 1954.

Salesmen are given authorization with a maximum weekly amount stated and a supply of blank drafts. Arrangements have been made by the company with 2000 institutions to cash the salesmen's drafts drawn upon the company. Drafts are presented by the salesman to hotels or transportation offices to cover weekly expenses and an expense statement is mailed to the home office detailing the claims. As a result individual expense checks do not have to be issued to travelers and no money is tied up in advances to salesmen.

"Integrated Data Processing for the Smaller Office"—Ralph W. Fairbanks, *Office Management*, June, July 1954.

Emphasizes the point that systems and procedures work resulting in significant improvements through "integrated data processing" is possible now in all offices without the use of newer electronic machines. Illustrates this theme with examples from improvements installed in a publisher's office.

Realistic Quality Standards — Work Simplification

by Vincent H. Kane

PAPER work continues to grow in volume and importance. Business managers are requesting better and more timely information to help solve the increasing complexities of modern business and to meet the demands of stiffer competition. At the same time the profit margins are narrowing and overhead costs must be reduced to a minimum. Management is looking to us as systems people to help improve clerical service and reduce costs.

How can we improve our clerical work procedures? The first step in any systems project is to study the needs of the business. We should determine what information is needed, when it is needed and how it is to be used. In most companies we will find that a great deal of simplification in paper work can be accomplished from employing realistic quality standards—quality standards that are fitted to the needs of the business after due consideration of cost factors.

My article deals with two general areas of quality standards, which are:

1. The requirements for clerical service.
2. Applying quality control and sampling techniques to clerical work.

Clerical service is in itself unproductive; it increases overhead without increasing revenue. We in the systems field must understand the requirements of management and the need for service to outsiders. We should keep abreast of new developments in management techniques and be prepared to assist with the establishment of clerical procedures to provide management with the information it needs.

Cost distribution is an area of clerical work in which we find wide variation in method and application. The object is to provide a satisfactory distribution of costs in the least time and effort. We should know how the cost data is used, understand the degree of exactness that is significant and use our imagination to help develop procedures that include all reasonable short cuts. We will find many instances where costs are accumulated in meticulous detail and are later distributed to several accounts at approximate percentages. Many cost projections are based on broad assumptions and the results cannot be better than rough approximations. Cost procedures that are too detailed and which over-emphasize the importance of exactness often provide less reliable and less useful information than other procedures maintained at considerably less overhead cost.

The distribution of the gross payroll may involve many detailed calculations of hours at specific rates. In addition, employer's payroll taxes, industrial insurance and other payroll burden items may be computed separately and in great detail. This requires much time and effort. A review of the payroll may disclose that average rates of pay and payroll burden can be used. Payroll charges may be controllable by hours and, if average rates are satisfactory, the distribution can be greatly simplified without reducing the value of the information. Let us consider an example where these conditions were found. This company has a payroll of about 300 employees and uses a process cost system. The daily time slips were priced and extended at actual pay rates. Later the hours and amounts were accumulated for each individual and for each cost classification. In studying the cost system it was found that the substitution of average hourly rates by department would have no significant effect on costs. The procedures were then revised to accumulate the hours by rate for each employee. At the end of the pay period the hours were totaled and extended to determine the gross pay for each employee. The hours for each department were summarized by account and were agreed in total with the paid hours. Average hourly rates were

THIS PAPER was presented at the Third Annual Conference of SPA's San Francisco Chapter in April. Mr. Kane heads the Management Advisory Services of Price Waterhouse & Co., San Francisco.

computed for each department and were applied to the total hours for each account to distribute the payroll dollars. The clerical work was reduced by more than fifty per cent.

Stores inventory accounts are often charged with small amounts of freight. This requires allocation of the freight to the related items, posting to the stores accounts, and including the freight in the average unit prices. Consideration should be given to expensing small freight payments of, say, five or ten dollars. Similar treatment may be appropriate for small items of sales tax, use tax and cash discount. Stores items which are issued frequently and which have small total value require a large amount of clerical work in relation to their total cost. Satisfactory costs may often be obtained with less clerical effort by expensing these items at the time of receipt. Unit costs of stores items may be carried out too far and the work increased unnecessarily. The unit cost of the item and the average quantity issued at a time should be considered when determining how far to extend unit prices.

Cost systems should be based on simple, easily understood principles. The cost procedures should provide for uniform treatment of transactions with as few exceptions to the rules as possible. There are usually several methods that can be used for the distribution of each item of cost. Since more than one method will often accomplish similar results, we should choose the method which is the most simple and direct.

In companies of medium to large size a substantial clerical saving can often be realized through the elimination of cents from the accounting records. The purpose of eliminating cents from the accounting records is to save time which is possible by writing fewer numbers in the accounting records. Also in writing fewer numbers the possibility of error is reduced. The speed of adding, subtracting, multiplying and dividing smaller numbers is increased. Reports can be prepared more quickly from records which contain only dollars.

When can we eliminate cents? It is apparent that cents must be retained in those records which record the receivables from and payables to other parties. The records for payrolls, accounts receivable, accounts payable and cash must contain cents. However, the cents may be dropped when we are recording cost distribution, stores purchases and issues, sales analysis, deferred charges, plant and equipment and provision for depreciation. Cents may be eliminated from all accounts except those with outsiders or may be eliminated from only a number of the remaining accounts. The decision should be based on individual circumstances. If cents are to be eliminated it should be done the first time the numbers are written for internal use so that the greatest savings may be realized.

Let us consider a few applications of cents elimination in our accounting records.

Stores Records— Charges and credits to the stores accounts can be made in dollars only. However, the unit prices of stores items of small value per item would continue to be priced to the nearest cent or perhaps even hundredth of a cent. Issues should be priced at the unit prices and extended to the nearest dollar. The time saved in pricing, posting and summarizing a large number of stores requisitions should be substantial.

Voucher Register—If a columnar voucher register is used, cents can be omitted from all columns except the total column. The difference between the total column and the total of the detail columns would be posted to the cents elimination account. Considerable time should be saved in entering, adding and posting the amounts in dollars only. The advantages of cents elimination should apply to other methods of voucher distribution.

Cost Records—All charges and credits to the accounts could be in even dollars. All transfers and distributions of costs could also be in even dollars. The accounting work would be reduced and report preparation facilitated.

When is it most profitable to eliminate cents?

(1) When there is a large volume of internal work.

(2) When many of the amounts used in the internal accounting are originated within the company. Under these circumstances the amounts may be originated in dollars only and we do not have the trouble of eliminating cents.

(3) When the internal accounting is not a by-product of the accounting with outsiders. This can be best illustrated by an example in which it is not profitable to eliminate cents. If the payroll distribution is determined on tabulating equipment from punched cards which are also used for preparing the payroll to employees, information on the punched cards must be in dollars and cents to arrive at the correct amounts due the employees. Under these circumstances it would not be profitable to eliminate cents before the total of the payroll distribution had been determined.

The Treasury Department recently announced that for Federal income tax purposes pennies may be eliminated in the processing of figures relating to such internal

transactions as accounts payable, sales and payroll distributions. Under this system pennies are eliminated at the earliest stage of the accounting operation. Amounts ending in 50 cents or more are rounded upward to the next dollar; amounts less than 50 cents are dropped. Variances resulting from these adjustments are recorded in a penny elimination acount. At year-end the balance in this account is picked up either as additional income or expense whichever is applicable. Once adopted the system must be maintained with reasonable consistency (Rev. Rul. 54-4, IRB 1954-1).

Useful Records

Accounting records should contain only that information which we expect to use. Occasionally, management asks for information that is not readily available from records and the information must be built up for the occasion. The accounting supervisor may feel some embarrassment for not having the information readily available and may install a permanent record containing information that may seldom or never again be used. Some accounting supervisors often go even further than this and try to anticipate possible requests for information. This obviously increases the cost of accounting and slows down the reporting of useful information.

We find many instances where unnecessary description or reference information is added to the records. The customer's ledger account may record, in addition to the date and amount of the invoice, the customer's purchase order number, production order number, invoice number and similar information which in most companies is referred to very infrequently. Accounts payable checks to vendors may contain in the remittance section, in addition to date and net amount paid, the purchase order number, invoice number, gross amount, cash discount amount and other information which usually is not used. However, invoice numbers should be shown for freight bills for the information of the carriers. Sales order registers and similar journals may contain descriptive information that is seldom used. When considering when to eliminate questionable information it is often helpful to have a record kept for a representative period of the instances when the information in question was used. Later this record will be useful in comparing cost and other factors when deciding whether the information should be eliminated.

Clerical work can often be simplified, and reporting of information accelerated by the elimination of unnecessary detail from our quantity records. Records of sales orders, sales statistics, operating statistics and inventories often contain quantity information recorded in units that are far smaller than need be. Lumber or logs may be stated in board feet that could be expressed in thousand board feet. Items may be stated in each that could be expressed in units of hundreds or thousands. Materials may be stated in pounds that could be stated in hundred pounds or tons. Records containing fewer numbers are easier to balance and easier to read. There are many instances where quantity records can be simplified by using larger units and thereby eliminating a large volume of unnecessary detail.

There are many instances where there is too much emphasis on the presentation and appearance of a report. Reports are recopied that can be issued in their original form. In addition to an increase in clerical costs, such reports are delayed and may lose much of their usefulness. The quality of the paper or method of reproduction may be better than is actually needed. A supervisor may insist that routine letters or reports that contain a typing correction must be rewritten. A good procedure to follow is first to determine the most economical method of performing the clerical service, then it may or may not be necessary to upgrade the method to obtain satisfactory results.

Applying Quality Control To Clerical Work

Most companies do not begin to appreciate the possibility of applying sampling (spot checking) techniques to accounting for routine business transactions. Neither do they appreciate how much their present practices cost in time and money. Detailed checking is permitted to continue unchallenged because (1) they feel that absolute accuracy is essential, and (2) they are unaware of the protection they can get at substantially lower cost from a program of quality improvement and the application of sampling techniques.

Quality control and sampling techniques are not new. They have been used in the factory with great success for many years. There, they have been applied to control something whose implications in relation to business and customer relations far exceed those of clerical accuracy—the quality of the product the company makes and sells.

One of the reasons a company may be reluctant to employ sampling techniques is that it may be afraid the number of errors will be too high. It may even have figures to show that the present incidence of errors is unacceptable. More often than not, this condition is the direct result of the fact that the company does not have an adequate program for improving the quality of its clerical work. Many companies merely inspect and correct individual documents. They do not use the results to forestall future errors.

Quality improvement is not the exclusive property of any sampling method or even of sampling itself; in fact, the techniques are identical under all methods.

a. Speedy identification of errors
   - — by source (individual or group)
   - — by cause

b. Prompt correction of the reason for the errors

c. Application of social pressure by having each employee's quality status known to all.

Once the company adopts the idea of sampling, it is confronted with the problem of determining (1) what margin of error it will permit, and (2) how large a sample is necessary to determine that the total being tested contains more or less than the permitted number of errors.

Companies should determine the number (or dollar amount) of acceptable errors they will permit by taking into consideration a number of factors:

The dollar effect of the errors.
The cost of finding them (the test checking work).
The cost of correcting them.
Their effect on customer or employee relations.
Their effect on future actions (i.e., whether the error will be compounded), etc.

Some of these factors are difficult to estimate and to evaluate and to reduce to a single figure—number or dollar amount of acceptable errors. But such difficulty should not be an excuse for avoiding sampling.

The size of the sample needed to test the total must also be determined. This can be done by rule-of-thumb or scientific techniques.

1. Rule-of-thumb techniques usually, although not necessarily, result in test checking too many items since companies tend to stay on the conservative side.
2. Scientific techniques determine the quantity needed to be tested with far greater accuracy than rule-of-thumb methods. These techniques may not only be useful per se but also because the assurance they provide may make companies more willing to adopt sampling. The techniques employ the law of probability, and consequently some complicated mathematical formulas, but portray the results in simple and easily understood tables. These techniques are known as statistical sampling, sequential sampling, etc.

Judgment must, of course, be exercised in selecting areas in which to apply spot-checking techniques. As a rule the areas are those in which there is a large number of transactions of relatively small unit value—material issues, piece rate tickets, payroll distributions, petty cash expenditures, public utility bills, etc. Obviously when the public is directly affected, standards of accuracy should be somewhat higher.

There are two broad applications of statistical sampling methods to accounting and office problems. These are:

(a) The control of the quality of large-scale clerical operations through the testing of samples, and
(b) the acceptance or rejection of lots of material or sets of data on the basis of tests made on samples.

The quality of output of a large-scale clerical operation is generally measured in terms of the number or per cent of errors. Statisticians divide errors into two types: (a) the random chance errors which are bound to occur occasionally in any large clerical operation and (b) assignable errors which are due to something going wrong with the operation. For example, the occasional punching of the wrong key of an adding machine would be random chance error, while a machine break-down causing 3 to add when 2 was punched would give rise to assignable errors. Similarly an occasional transposition by an employee not given to this type of error might be considered a random chance error, although frequent transpositions by an employee with a quirk in that direction would be classified as assignable errors.

Knowing the average over-all error rate of an operation, it is possible to set random chance error limits for samples of different sizes. Random samples of the operation can then be tested, and when the number of errors in a sample falls within the random chance error limits it can be assumed that only random chance errors are present. Whenever the number of errors in a sample exceeds the limit, it is assumed that an assignable error is present and steps are taken to find and eliminate it. When the random chance error rate is low, and management is willing to ignore errors of this type, it is possible to effect substantial clerical savings by substituting tests of samples aimed at detecting assignable errors in place of 100 per cent checking routines.

Control limits for random chance errors can be established through the use of the relatively simple mathematical formulae given below. The upper control limit (UCL) is given by the equation $UCL = np + 2d$, where $n =$ size of sample to be tested, $p =$ average error rate for the operation, and d, the standard deviation of the error rate, is given by the equation $d = \sqrt{np}\,(1-p)$

Thus, for example, if a public utility with 25,000 invoices per day and an error rate of one error per 1,000 invoices is interested in setting random chance error limits for samples of 5,000, the calculations would be as follows:

$$\begin{aligned} d &= \sqrt{np\,(1-p)} \\ &= \sqrt{5000 \times .001\,(1-.001)} \\ d &= \sqrt{5 \times .999} \\ &= \sqrt{4.995} \\ &= 2.23 \\ UCL &= np + 2d \\ &= (5000 \times .001) + (2 \times 2.23) \\ &= 5 + 4.46 \\ &= 9.46 \end{aligned}$$

Under these circumstances, whenever a sample of 5,000 invoices contained 10 or more errors an investigation

would be made to determine what had gone wrong. When samples contained nine errors or less the day's work would be passed without further checking. It should be pointed out that under these procedures samples should be drawn at random and should be representative of the entire day's operations.

"Acceptance sampling" includes the techniques involved in testing a sample for the purpose of forming an opinion concerning the entire lot or "population" from which it is drawn. In "acceptance sampling" one is not present as the operation creating the lot is carried out and so is unable to test control samples as under the quality control procedures described above. Rather one is faced with the problem of making a single decision as to whether to accept or reject a given lot of material or data.

Rule of Thumb

Acceptance sampling can be by rule-of-thumb of the tester or by use of acceptance sampling tables that are based on predetermined risk factors. It can usually be shown that the average tester's rule-of-thumb sample is far larger than necessary so that his risk of error is relatively small, although the cost of his test may be unnecessarily high. There are three types of acceptance sampling plans: single sampling plans, double sampling plans, and sequential sample plans. The last-named type has the advantage of accepting very good and rejecting very bad lots with a minimum of testing, although in-between lots may require a considerable amount of testing before a decision is reached. It should be pointed out that statistical sampling plans are based upon the assumption that the samples are drawn at random from the entire lot being sampled. It can be shown that conclusions based on samples covering a short period of time are likely to be far less reliable than those based on random samples of the same size.

In many companies the cost of checking vendors' invoices of small amount far exceeds the savings from corrected invoices. A comprehensive test can be made of the invoices to determine the distribution of invoices by size, the dollar amount and number of errors by size of invoice, and the cost of checking. With this information the break-even point for checking can be determined. For example, it may be found that the cost of checking invoices under $100 exceeded the savings. Then all invoices of $100 or more would be checked while those under $100 could be test checked periodically for possible changes in conditions which might change the break-even point.

Many employees believe that all clerical work should be as exact as is humanly possible. This approach can do much to increase costs and will often reduce the usefulness of the service. Conversely, we have many employees who through inability, lack of understanding or carelessness, will turn out work that is unacceptable. The service requirements and the cost factors should be discussed with top management. Once management policy is determined appropriate quality standards should be built into the procedures.

A quality control program can do much to improve the clerical service. Special efforts are made to find errors, study errors and to eliminate them at their source. When error ratio is brought under control there is a natural tendency to speed up production. The use of test checking techniques for routine business transactions is growing in acceptance. Rule-of-thumb test checking has been replaced in a few progressive companies by statistical sampling techniques that employ the law of probability. Some companies claim that the use of a quality control program employing statistical sampling techniques has brought about a general improvement in the quality of service and a reduction in overhead. **s/p/a**

It's a fact

"Mechanization is always mentioned along with the statistics to show how the office 'lags behind' the shop. Figures do show that almost 10 times more money is invested in factory machinery than in office machinery. But the only thing this proves is that any comparison between the number of factory workers and the number of office workers is inconclusive, because machinery has vastly increased the individual productivity of the factory worker.

"Those who speak of mechanization seem to imply that office executives resist or ignore modern machines. The fact is that office machines are available to do only part of the office job. There are no cases on record of any real office executives holding to quill pens, carrier pigeons, mental arithmetic, manual copying, and longhand letters. But there just aren't any machines that can type letters, file papers, handle switchboards, sort mail, or keep track of appointments. In other words, though we have seemed on the verge of a revolution in office methods since the advent of electronics and cybernetics, there are still no machines with business-school diplomas."—Forgotten Facts About Office Efficiency by ROBERT L. BURLEW, *Office Executive*, Feb. 1954.

Carbon trick

"One trick often invoked in the carbon paper field is inclusion in a set of carbons and forms of one sheet of special carbon or translucent paper which produces a master that can be further reproduced by gelatin or spirit hectograph or diazo to make as many more copies as may be needed."—From "Modern Office Reproduction Methods," ARCH B. JOHNSTON, at the Third Annual Conference on Systems and Procedures, San Francisco.

Self Portrait

The Small Procedure Department

by Karl H. Klein

THIS little group does a big job—administering the procedures of the Stanolind Oil Purchasing Co. Mr. Klein heads this highly efficient staff. A member of the Tulsa Chapter, SPA, Mr. Klein was president in 1953-54.

EVERY company has accounting and treasury or sales departments of some sort, but procedure departments are usually found in the larger companies. Among smaller companies having only a few hundred or even a few thousand employees, the procedure department's work is generally shared by the controller, the office manager, the secretary-treasurer, the chief accountant and the assistant to the president.

Obviously, then, the procedures staff in the smaller companies cannot take itself for granted as readily as an established procedure department that serves one of the corporate giants. Unless developed cautiously, the small procedure staff is likely to lose its impartial investigative and advisory effectiveness under a load of operating routine.

The care and feeding of the procedure department in our firm has been especially circumspect, since it is staffed by only three people: a supervisor, who reports to the financial vice president; an assistant; and a stenographer. We started out in 1946 as a one-man department, grew to a total of four, then settled back in 1950 to our present number.

The big job of our small department is to serve the company as coordinator of its internal operations. Our company has 220 employees, mostly of the white-collar variety, in 14 field offices and its Tulsa headquarters. It operates in 10 states where it buys, sells, and trades large volumes of crude oil.

Within the company we move from department to department and from desk to desk, wherever most needed at the time, in behalf of maximum economy commensurate with effectiveness and proficiency. Within this broad function, our specific functions are:

(1) To act as coordinator, investigator, and advisor, on special problems of procedure usually involving two or more departments.

(2) To coordinate and supervise the company's records management program that includes:
   (a) An annual review of each of the company's printed and numbered forms.
   (b) An annual review of all reports that are regularly prepared by one department of the company for another department or for management.
   (c) The establishment of schedules and procedures for the retention and destruction of the company's inactive records.
(3) To write and revise the company's general operating procedure manual, the general accounting manual, the punched-card accounting procedure manuals, and other instruction manuals as needed.
(4) To evaluate new office machines for possible applications to each department's particular needs.
(5) To develop training material out of our familiarity with every department's work.

Our work usually comes to us from section and department heads who bring us ideas that need development and problems that cross departmental borders, and together we work out each situation to the mutual satisfaction of all concerned. Management, too, assigns us special studies, and as time permits we ourselves initiate surveys after proper clearance. We like it this way, for then we know that those whose work is affected and whose help we need, are ready and willing to work with us.

In recent weeks we have assisted 8 departments of our company on 12 special problems. Three of these problems were limited to the requesting department's work, and 9 were inter-departmental. Of these, 6 not only were inter-departmental but required consultation with a number of customer companies that would be affected by suggested changes in our internal procedures. Requests for the review of 10 of the 12 problems came directly from department heads.

One reason we get along so well with the section heads and department managers is our mutual dislike for long reports and complicated diagrams. We do not use stop watches, and our occasional process and flowcharts are simply step-by-step descriptions of how a job is done, written in plain English, without hieroglyphics. If a memorandum will do, we don't write a report. If a conversation will do, we don't write a memorandum.

One bit of paperwork that we like is a list of our special assignments, in chronological order, showing the name of the person requesting our aid, the date of origin, the date of completion, and the departments and individuals consulted before completion. It is sometimes tendered uninvited to management, when we feel an evaluation is needed of the work we are doing. It is used by us to make our own evaluation of whether the work we are doing is worth the effort and the expense: Are we doing too many unimportant jobs? Are we spending all of our unscheduled time in only one or two departments? Are we spending too much time on only one or two inter-departmental functions? What are the departments and the operations that seem to require or receive our attention most frequently?

We like this record, too, because it helps us remember that almost every problem extends across a surprising number of departments to the desks of a surprising number of individuals. This encourages us, because it reflects the highly specialized, interdependent nature of the departments in our company and of the jobs within each department. It is this inter-dependent specialization, we believe, that creates a clear and permanent need for our procedure department, or for some similar and equally effective coordinator of internal operations.

Records Management

Our company uses 160 printed forms in its offices and 240 report forms, excluding more than a hundred that are prepared solely for some agency of state or federal government. Our object in reviewing all forms and reports, of course, is to weed out and keep out those that are unnecessary and to improve those that are needed. Our cradle-to-grave program seeks improvements in (1) design, (2) printing and preparation, (3) distribution, (4) use, (5) filing, and (6) storage and destruction. During the first round of paperwork simplifications, savings were found rather easily in each of these 6 stages. Now we find that the printing and preparation of forms and reports is the phase most productive of savings, due mainly to the new processes and equipment that have been marketed in recent years.

Recently, we decided it was time to switch our efforts from the elimination of unnecessary paperwork to the improvement of the so-called unavoidable paperwork. In fact, we decided we would fight paperwork and created some new "records control records". These are simply analysis sheets, one for each form and each report. Each sheet basically is a check list of things to look for and think about when reviewing a form or report, plus identification of the form or report by name and number, plus a statement of its purpose, a record of the quantity (of forms) last ordered, and the names of the individuals consulted in completing the review.

This record, like our list of special assignments, is also used to determine the number of individuals and departments that prepare and use each form and report, and whose ideas, problems and efforts need coordination. Each of our 240 reports, for example, is used by an average of 4 different persons, in addition to the person who prepares it. Our analysis sheets also help us keep each review from wandering, or from becoming super-

ficial or from coming to a stop before a thorough analysis is made.

Forms and Reports Control

The form analysis sheets are kept in a book that is divided by departments, with each sheet filed in the section for the department that prepares the form. This isn't exactly a functional file but it fills our need. One section of the book is for forms that are prepared by more than one department. We also have, of course, a numerical form file that contains samples of each form, approved drafts of new forms, and related data such as old analysis sheets that are replaced by new ones on the occasion of each annual review.

Our company's forms control procedure provides that when pre-determined minimum quantities in stock are reached, we are to be notified by the stock room. The minimum quantities are set to provide a 6-month interval between orders of some forms, a year's interval for others, and our analysis sheets are set up on an annual basis. The result is that each form gets a thorough going-over at least once a year, and for some forms the check-up comes oftener.

In addition to our report analysis sheets, we have a control record that consists of one sheet for each report, showing name and number of the report, name of the department and of the section that prepares it, scheduled interval and date or dates of release, and the names of those individuals (by title) who receive copies. The analysis sheets and control sheets are filed in similar manner—by department, by scheduled interval, and by assigned number. One sheet could do for both records, except that we know from experience that a new analysis sheet must be prepared at least once a year, while the control sheet on some reports will go along for years without change. Moreover, copies of each control sheet are held by the interested departments, while the analysis sheets are just for the procedure department's use.

Each report has a control number that is handy for reference, particularly since we have found it difficult to give many reports names that are neither long nor ambiguous. Each control number has a prefix letter for the department that prepares it and a prefix number indicating its scheduled interval. Thus "A2-6" is recognized as an accounting department report prepared each week; "C4-6" as a contract department report prepared semi-annually, etc.

Records Filing, Storage and Destruction

The company's active files are the responsibility of the department creating or using them. In a small company like ours, with numerous small, highly specialized departments, we have never felt the need for central files, although there are several hundred file drawers filled with current records. Apparently the decentralization of our files works, for we hear no complaints that files can't be found whenever they are needed.

Our function with respect to the company's inactive records simply is to see that a satisfactory compromise is reached between prudence and economy in their storage and destruction. The day to day transfer of some to storage drawers and others to microfilm, and their eventual destruction if they not scheduled for permanent retention, are guided by written instructions that we prepared several years ago and now are part of the general operating procedure manual.

One result of our studies on this subject was the allocation of specific storage space and equipment to each department, and now about the only time we are brought into records storage and destruction matters is when this space or equipment becomes unsatisfactory to some department. Then re-shuffling or enlarging the space and equipment, or a revision in the procedure, may be necessary.

Procedure Manual

There are 36 general operating, 24 general accounting, and 68 punched-card accounting procedure letters, in addition to 2 short manuals of instructions on the measuring, sampling and testing of crude oil.

New procedure letters are rarely required now, and most of our work on the manuals is to keep them current and study them for better style or for improvements in the procedures themselves.

Instruction manuals, we have learned, are more important before they are written than after. It is the investigations, discussions and decisions necessary before approved procedures can be issued or revised that keep our departments working together as a team. Of course, manuals are also useful after they are written. One way our company uses them is as a training guide, and for this reason we always preface each instruction letter with "general comments" that explain the need for the work that is outlined and just where it ties in with related work described in other instruction letters.

We review each procedure letter once a year, using an analysis sheet very similar in purpose to the form and report analysis sheets. Like the latter, the procedure letter analysis sheets are used, among other things, to designate the many different departments and individuals necessarily consulted to perfect each procedure and keep it current.

Before our analysis begins we circulate each letter, and a questionnaire, to the department heads affected by the instructions. The questions are few and simple: (1) Does any instruction conflict with actual procedure? (2) Is any instruction incomplete or confusing? (3) Have you any ideas for improvements? Each question is followed by a space in which the troublesome instruction can be designated by page and paragraph number and by the name of the person to see about it. Thus, the busy department head doesn't have to think out his criticism in detail or write it down. He knows one of us will come

by to discuss the problem or improvement at his convenience or at the convenience of the person he designates.

Office Machines and Services

We welcome the office system forms and equipment salesmen and rely on them to keep us posted on what's new. When evaluating new equipment, we make our own studies of comparative costs and performance, and frequently find that the best way to save money is to spend money for the new models or different machines. An electronic punched-card calculator, advanced models of other punched-card equipment, a photo-copy machine, a microfilm camera and reader, a suction-feed addressing machine, and a continuous forms burster, are examples of purchases or rentals the company has made on the basis of our studies.

We rarely compare the cost, performance or necessity of ordinary typewriters, adding machines, calculators, or filing equipment when request is made for their purchase, and we have nothing to do with office furniture. These items are requisitioned and ordered, if approved, in accordance with written procedures, and the purchasing agent works with the users in making each selection. Also out of our province are such office services as mailing, duplicating and stationery and supplies.

Training

In addition to preparing procedure manuals that have definite training value, we prepare flow of work charts and written descriptions of departmental functions that are used in briefing key employees of affiliated companies who are sent to us from time to time to learn about our company's organization and operations. The short course that we have developed for these students lasts two days. The offices of our department heads are the classrooms and there is a written schedule to follow as the students proceed from one room and one subject to another. The text book, another procedure department product, is a 3-page outline and diagram of the company's operations and organization.

Employee Relations

We are not the employee relations department of the company, and human relations is not our specific responsibility, yet we cannot avoid it. As a matter of fact we have a dynamic employee relations opportunity that is not available to any other department, for sooner or later we interview every employee and talk with him about what every employee is eager to talk about—his job and its importance to the total effort. This visit may be while we are investigating the details of some special problem, or while we are tracking down the need for a form or a report, or while we are writing a procedure or studying the uses of a new machine, but eventually, once a year at least and usually oftener in the general office, we sit down with and ask for the help of every employee in the company.

Everyone likes to have someone seek his views, especially on a subject as familiar to him as his job. But someone is needed to ask him, to listen, and to do something about the ideas he unloads. That asking, listening, and doing, is our procedure department's best and biggest job. No other effort we exert is more productive insofar as simplifications and savings are concerned. It is employee relations at its best.

Ours is a unique opportunity to keep alive throughout the company an appreciation of the many inter-dependencies on which the company's operations rest. We know we can make a major contribution to the company's human relations, provided we are sensitive to the rights, reflexes and desires of human beings. We know too, that if we conduct ourselves carelessly, then like a locomotive that leaves the track, we will be mainly disruptive. To help us remember this, and to be certain we reach everyone in the general offices, we have a list of general office employees and on this list note the date or dates we have checked some form or report or procedure with each person. The names of those individuals we have not talked to soon stand out and it is never difficult then to find a good reason for a visit to solicit their aid. This is not only dynamic employee relations. It is, we think, the best possible suggestion system.

Human relations opportunities in systems and procedures are not peculiar to our company or to our procedure department. Surely they exist in every procedure department whatever its size, and regardless of how big and how good the employee relations department is.

Once Upon a Time

In the early days of our department the job was to dig a new channel where the company's internal operations would flow forcefully between maximum effectiveness and maximum economy. In that heavy digging a lot of savings were discovered that won't be found again unless we continue to keep the channel open. Keeping the channel open, we find, or re-routing it, as changes occur like shifting sands in personnel, policies, laws, customs, costs, and equipment, is a different proposition than the original digging. It is a matter of preventive maintenance, which seldom produces spectacular savings, but "an ounce of prevention" holds here.

Like every other department the procedure department needs the full support of management. More than other departments the procedure department needs the confidence of the other departments. Looking now beyond these fulfilled needs for the reasons our small department stays in business, we find these three:

(1) Full use of the informal ease with which a small procedure department can function.

(2) Full use of the outstanding human relations opportunity in our work.

(3) Keeping the department small, the job big, and the work free of operating routine. **s/p/a**

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